

# Ares I First Stage: Powering Exploration

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## Abstract

**T**he mission of the National Aeronautics and Space Administration (NASA) is not simply to maintain its current position with the International Space Station and other space exploration endeavors, but to build a permanent outpost on the Moon and then travel on to explore ever more distant terrains. The Constellation Program will oversee the development of the crew capsule, launch vehicles, and other systems needed to achieve this mission. From this initiative will come two new launch vehicles: the Ares I and Ares V. The Ares I will be a human-rated vehicle, which will be used for crew transport; the Ares V, a cargo transport vehicle, will be the largest launch vehicle ever built. The Ares Projects team at Marshall Space Flight Center (MSFC) in Huntsville, Alabama is assigned with developing these two new vehicles. The Ares I vehicle will have an in-line, two-stage rocket configuration. The first stage will provide the thrust or propulsion component for the Ares rocket systems through the first two minutes of the mission. The First Stage Team is tasked with developing the propulsion system necessary to liftoff from the Earth and loft the entire Ares vehicle stack toward low-Earth orbit. Building on the legacy of the Space Shuttle and other NASA space exploration initiatives, the propulsion for the Ares I First Stage will be a Shuttle-derived reusable solid rocket motor. Progress to date by the First Stage Team has been robust and on schedule. This presentation provides an overview and update on the design and development of the Ares I First Stage Propulsion system.



Solid Rocket Motor Test

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## Ares I First Stage: Powering Exploration

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## Agenda




- ◆ Introduction
- ◆ Schedules
- ◆ First Stage Progress to Date
- ◆ First Stage Current Challenges
- ◆ Conclusion




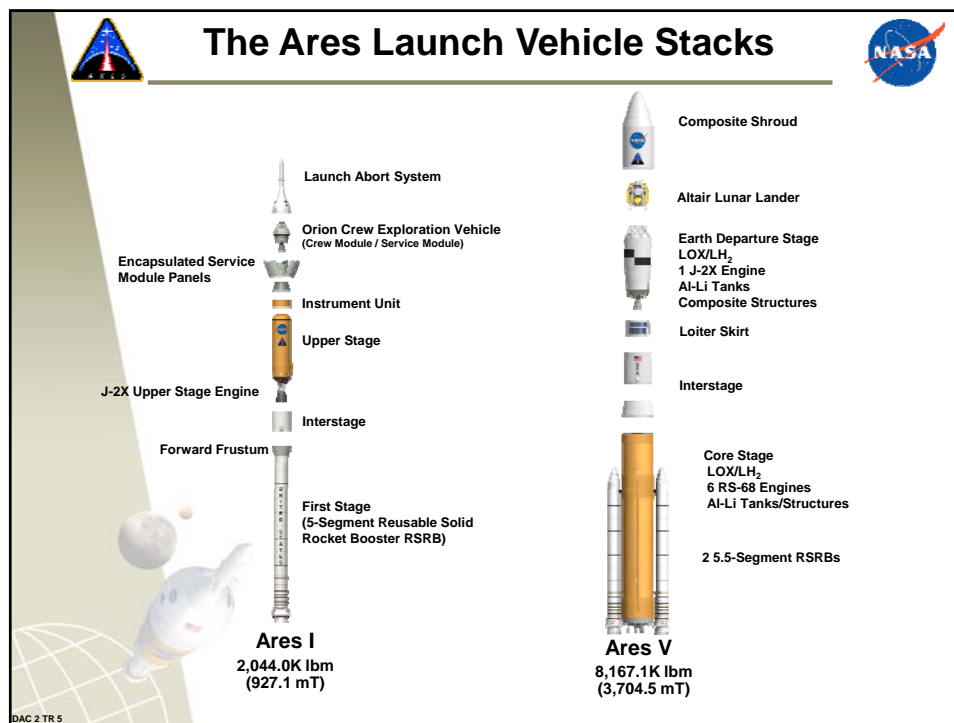


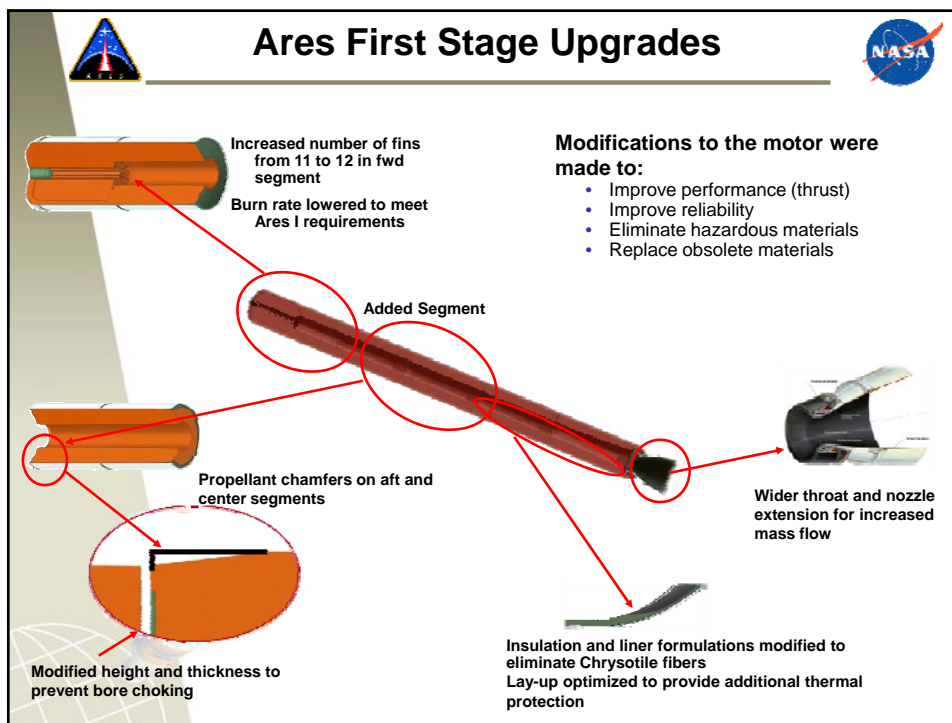
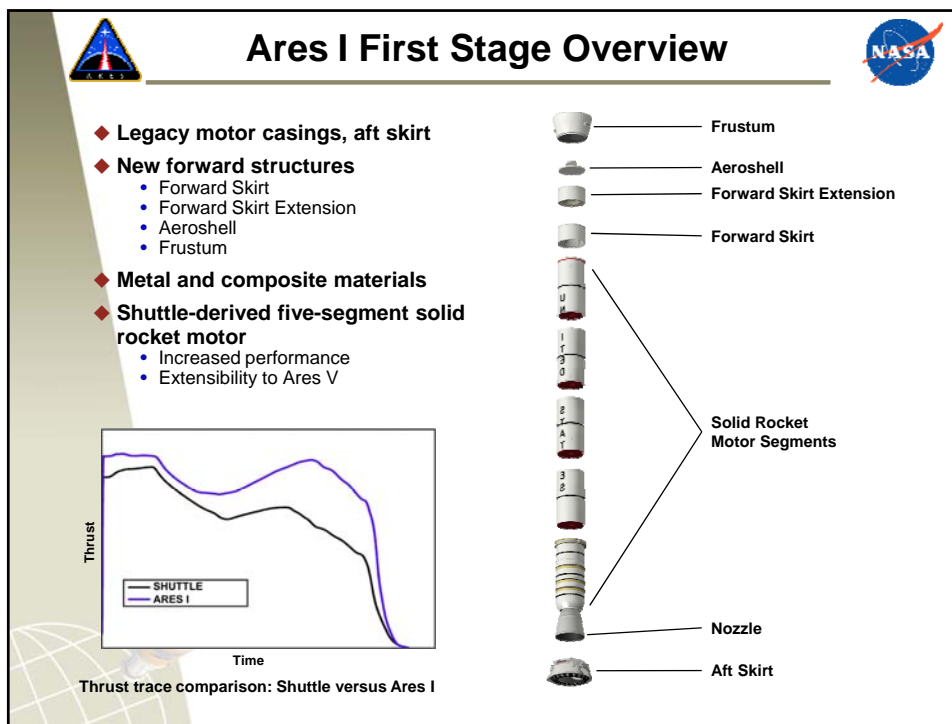
## Introduction

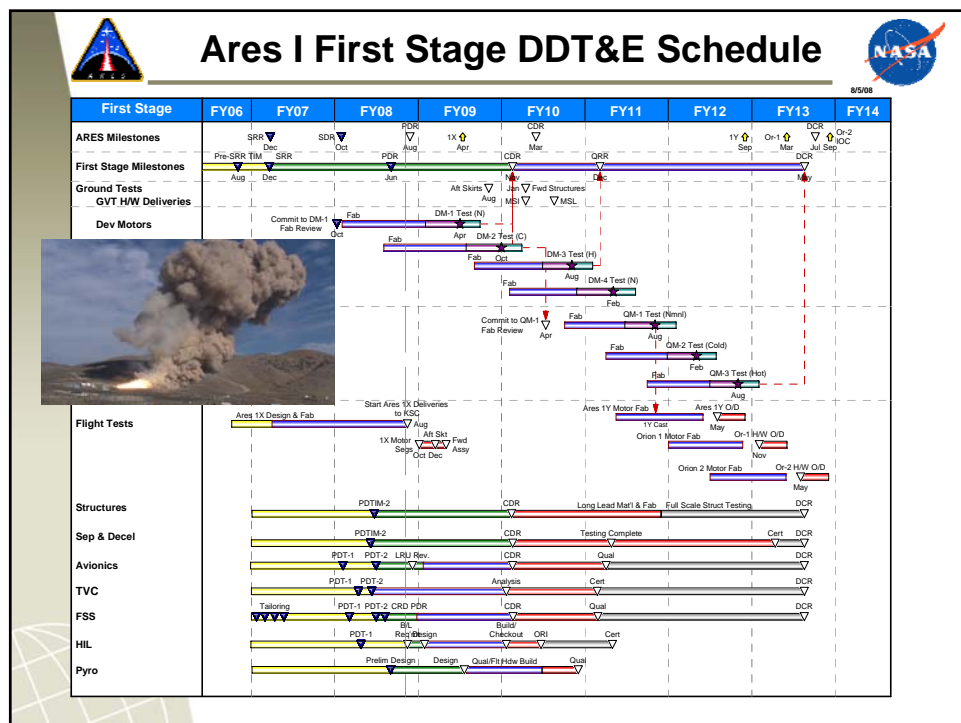
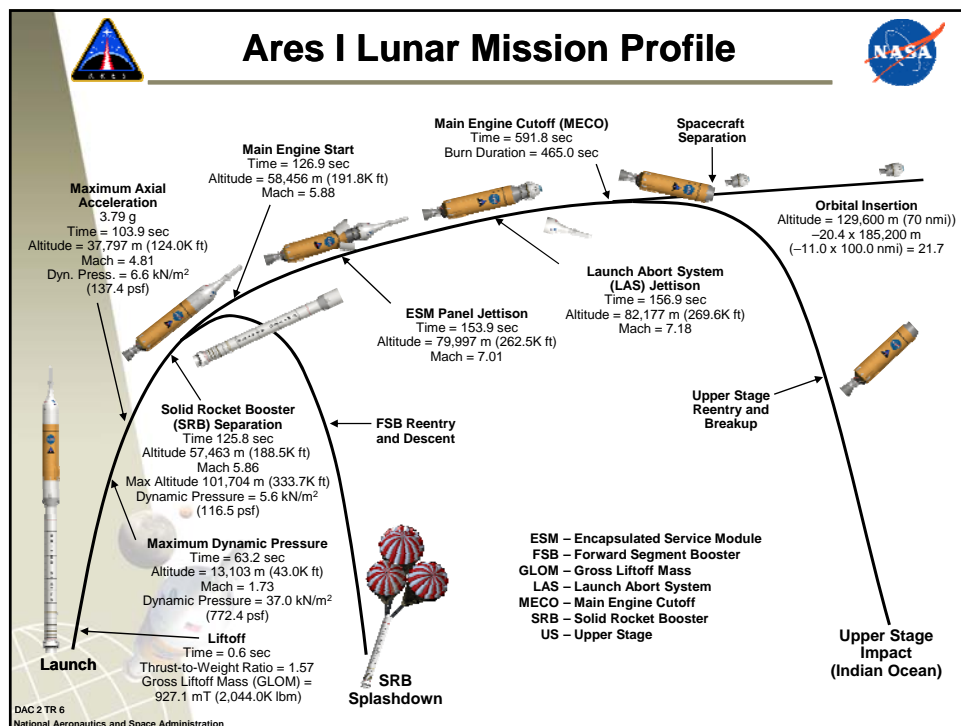



- ◆ Building on the legacy of the Space Shuttle and other NASA space exploration initiatives, the propulsion for the Ares I First Stage will be a Shuttle derived reusable solid rocket motor.
- ◆ Significant progress has been made to date by the Ares First Stage Team.
- ◆ This brief status provides an update on the design and development of the Ares First Stage propulsion system.














## First Stage Progress to Date




- ◆ **Successful Preliminary Design Review Completed in June, 2008**
- ◆ **Major Test Programs**
  - Parachute drop tests
  - Stage separation pyrotechnics
- ◆ **Substantial Hardware and Tooling in Process**
- ◆ **Several Major Items Manufactured**
  - Modal survey inert (MSI) segments
  - Modal survey loaded (MSL) segments
  - Process simulation article 2 (PSA) Nozzle
  - Demonstration motor (DM-1) Nozzle
  - DM-1 segments through insulation
- ◆ **Ares 1-X Support**
  - Motor segments being instrumented
  - Pyrotechnics for flight termination system and separation under qualification testing
  - Fifth segment simulator under construction
  - Aft skirt mods to install ballast and deceleration motors are underway
  - Progressing toward KSC deliveries






## Ares I Drop Test Status



- ◆ **Three-stage recovery system.**
- ◆ **The Ares I Deceleration Subsystem consists of a 11.5 ft. pilot, a 68 ft. drogue, and three 150 ft. main parachutes.**
- ◆ **Completed 3 pilot and 2 single main basic performance drop tests to date.**
  - Measure parachute drag areas and inflation loads at various reefed positions
- ◆ **Conducted one drogue basic performance test in July.**
- ◆ **First basic performance test of a cluster of 3 main parachutes scheduled for January 2009.**
- ◆ **One design load and one overload test for the pilot, drogue, and main will be conducted in 2009 & 2010.**
- ◆ **All remaining drogue and main tests will be heavy drops using the Jumbo Drop Test Vehicle (JDTV).**
  - JDTV drop weight will be between 36K to 80K lbs.



Jumbo Drop Test Vehicle




## Drogue Drop Test






Parachute Test Apparatus  
Extraction from Aircraft




## Drogue Drop Test





***1st Drogue Drop Test  
(DDT-1)  
July 24, 2008  
Length 2:40***






## Full-Scale Separation Test







Full-Scale Separation Test Hardware Dry Fit




Full-Scale Separation Test Article in Test Stand




Full-Scale Separation Test Build-up

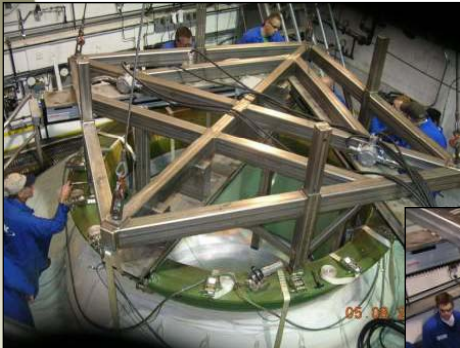


Successful Full-Scale Separation Test is Complete  
Measured Tip-off Loads, Shock, and Functionality of Separation System




## MSL Aft Segment Silastic J Removal





New Silastic J Removal Tooling Positioned on MSL Aft Segment



MSL Aft Segment Silastic J Removal







## RSRMV Nozzle Hardware





**DM-2 Fwd End Ring Housing  
Machining**



**DM-2 Throat Housing  
Machining**



**DM-2 Fwd Exit Cone Housing  
Machining**



**DM-2 Nose Inlet Housing  
Machining**



## Tooling — Forward Core





**Loading -401 Assembly into Lathe**



**-401 Assembly Rough Machined**



**Welding Stub Fins To Core**




**Assembling Fin To Core**




**Assembled Forward Core**




**MSL Fin Tooling Removal**




## T-97 Static Test Stand




T-97 static test stand upgrade and refurbishment nearing completion for DM-1 assembly and testing




Aft test stand disassembled, refurbished and reconfigured




Aft stand complete




47 load cells calibrated MSFC dead-weight calibrator




45 1.75-in bolts Inconel




T-97 facility paint and refurbishment




Mid-Span Support - delivery to T-97




Strengthened overload plates






## Mitigation for Thrust Oscillation




- ◆ First Stage motor internal oscillating pressures could potentially excite resonant conditions in the Ares integrated stack.
- ◆ Because we will not **know** for sure until we fly, contingency designs are underway today.
- ◆ A senior team just completed a detailed study and made recommendations that are now being implemented.
- ◆ Mitigation detunes the vehicle by reducing its overall stiffness and adding a moving mass to actively suppress the oscillation.



## Conclusion

- ◆ Ares First Stage design progress is robust (PDR complete).
- ◆ Ares I-X hardware is in fabrication.
- ◆ Recovery system testing is well underway.
- ◆ Separation testing has begun.
- ◆ DM-1 static firing is still slated for the middle of 2009.



## Questions



[www.nasa.gov/ares](http://www.nasa.gov/ares)